Georgia Mathematics

History of Mathematics

Adopted 2021

Mathematical Practices

MP. Display perseverance and patience in problem-solving. Demonstrate skills and strategies needed to succeed in mathematics, including critical thinking, reasoning, and effective collaboration and expression. Seek help and apply feedback. Set and monitor goals. Code Expectation HM.MP

1. **Make sense of problems and persevere in solving them.** HM.MP.1
2. **Reason abstractly and quantitatively.** HM.MP.2
3. **Construct viable arguments and critique the reasoning of others.** HM.MP.3
4. **Model with mathematics.** HM.MP.4
5. **Use appropriate tools strategically.** HM.MP.5
6. **Attend to precision.** HM.MP.6
7. **Look for and make use of structure.** HM.MP.7
8. **Look for and express regularity in repeated reasoning.** HM.MP.8

Mathematical Modeling

1. **Apply mathematics to real-life situations; model real-life phenomena using mathematics.** HM.MM.1
    1. Explain contextual, mathematical problems using a mathematical model. HM.MM.1.1
    2. Create mathematical models to explain phenomena that exist in the natural sciences, social sciences, liberal arts, fine and performing arts, and/or humanities contexts. HM.MM.1.2
    3. Using abstract and quantitative reasoning, make decisions about information and data from a contextual situation. HM.MM.1.3
    4. Use various mathematical representations and structures with this information to represent and solve real-life problems. HM.MM.1.4

Numerical Reasoning – Origins of Mathematics

2. **Explore and use historical number systems and computational methods.** HM.NR.2
    1. Use historical number systems to represent quantities. HM.NR.2.1
    2. Use historical multiplication and division algorithms. HM.NR.2.2
    3. Decompose fractions of the form 2/(pq) using the Egyptian method as recorded by Ahmes (Ahmose) in the Rhind Papyrus. HM.NR.2.3
    4. Compute lengths, areas, and volumes according to historical formulas HM.NR.2.4
    5. Describe the limitations of the Babylonian, Roman, Egyptian (hieratic and hieroglyphic), Chinese, and Greek number systems as compared to Hindu-Arabic numerals HM.NR.2.5
    6. Identify the number system and notation used by a society as an influence on the types of mathematics developed by that society. HM.NR.2.6
    7. Solve linear equations using the method of false position. HM.NR.2.7
    8. Translate ancient mathematical problems that involve linear, quadratic, or cubic equations into modern notation and solve them in a variety of ways. HM.NR.2.8

Logical, Mathematical & Investigative Reasoning – Ancient Greek Mathematics

3. **Engage in the mathematical and cultural accomplishments of the ancient Greeks in order to grasp the foundational aspects of modern mathematics.** HM.LMIR.3
    1. Prove statements in a deductive system by using its definitions, postulates, and axioms HM.LMIR.3.1
    2. Prove the first five propositions in Book I of Euclid's Elements. HM.LMIR.3.2
    3. Construct a regular pentagon with a straight-edge and compass. HM.LMIR.3.3
    4. Compute the areas of regular polygons by Heron's formulas. HM.LMIR.3.4
    5. Translate Greek geometric algebra into modern algebraic notation. HM.LMIR.3.5
    6. Find the first four perfect numbers using Euclid's formula. HM.LMIR.3.6
    7. Justify statements concerning figurate numbers using both graphical (as in the manner of the Greeks) and algebraic methods. HM.LMIR.3.7
    8. Solve systems of linear and nonlinear equations using Diophantus' method. HM.LMIR.3.8
    9. Explain the distinction made between number and magnitude, commensurable and incommensurable, and arithmetic and logistic, the cultural factors inherent in this distinction, and the logical crisis that occurred concerning incommensurable (irrational) magnitudes. HM.LMIR.3.9
    10. Describe the cultural aspects of Greek society that influenced the way mathematics developed in ancient Greece. HM.LMIR.3.10
    11. Describe the theories for the rise of intellectual thought in ancient Greece and the factors involved in its collapse. HM.LMIR.3.11
    12. Analyze factors involved in the rise and fall of ancient Greek society. HM.LMIR.3.12

Logical, Mathematical & Investigative Reasoning – Mathematics in the Middles Ages

4. **Engage in the mathematical and cultural accomplishments of the world's societies in the 5th century through the 15th century in order to grasp the foundational aspects of modern mathematics.** HM.LMIR.4
    1. Translate medieval mathematical problems that involve linear, quadratic, or cubic equations into modern notation and solve them in a variety of ways. HM.LMIR.4.1
    2. Use Khayyam's geometric construction to find a solution to a cubic equation. HM.LMIR.4.2
    3. Identify cyclic quadrilaterals and find associated lengths by Ptolemy's Theorem. HM.LMIR.4.3
    4. Investigate the relationships among the sides and angles of a spherical triangle. HM.LMIR.4.4
    5. Describe the algebraic and geometric contributions of Islamic mathematicians in the Middle Ages. HM.LMIR.4.5
    6. Describe the algebraic and geometric contributions of Chinese mathematicians in the Middle Ages. HM.LMIR.4.6
    7. Describe the transition of Hindu-Arabic numerals from regional use in the 10th century to wide-spread use in the 15th century. HM.LMIR.4.7
    8. Describe the transmission of ideas from the Greeks, through the Islamic peoples, to medieval Europe. HM.LMIR.4.8
    9. Describe the influence of the Catholic Church and Charlemagne on the establishment of mathematics as one of the central pillars of education. HM.LMIR.4.9
    10. Use historical multiplication and division algorithms. HM.LMIR.4.10

Logical, Mathematical & Investigative Reasoning – Mathematics of the Classical Era

5. **Engage in the mathematical accomplishments of Europe in the 15th century through the early 17th century in order to grasp the foundational aspects of modern mathematics.** HM.LMIR.5
    1. Use historical multiplication and division algorithms. HM.LMIR.5.1
    2. Use Cardano's cubic formula to find a solution to a cubic equation. HM.LMIR.5.2
    3. Explain the cultural factors that encouraged the development of algebra in 15th century Italy, and how this development influenced mathematical thought throughout Europe. HM.LMIR.5.3
    4. Identify the works of Galileo, Copernicus, and Kepler as a landmark in scientific thought, describe the conflict between their explanation of the workings of the solar system and then-current perspectives, and contrast their works to those of Aristotle. HM.LMIR.5.4
    5. Describe the mathematical contributions of Fermat, Pascal, and Descartes. HM.LMIR.5.5

Logical, Mathematical & Investigative Reasoning – Modern Mathematics

6. **Engage in the mathematical and cultural accomplishments of the world's societies in the late 17th century through the early 20th century in order to grasp the foundational aspects of modern mathematics.** HM.LMIR.6
    1. Determine tangents to quadratic curves using the algebraic techniques of Fermat, Barrow, and Newton. HM.LMIR.6.1
    2. Describe the influence the French Revolution had on mathematics education. HM.LMIR.6.2
    3. Prove that the summit angles of an isosceles birectangle are congruent, but that it is impossible to prove they are right without referring to the parallel postulate or one of its consequences. HM.LMIR.6.3
    4. Compare and contrast the hypotheses of the acute angle (Hyperbolic), the right angle (Euclidean), and the obtuse angle (Spherical). HM.LMIR.6.4
    5. Prove that under the hypothesis of the acute angle, similarity implies congruence. HM.LMIR.6.5
    6. Describe the societal factors that inhibited the development of non-Euclidean geometry. HM.LMIR.6.6
    7. Add, subtract, and multiply two quaternions. HM.LMIR.6.7
    8. Investigate abstract algebra and group-theoretic concepts. HM.LMIR.6.8
    9. Identify whether a given set with a binary operation is a group. HM.LMIR.6.9
    10. Explain how the ancient Greek pattern of material axiomatics evolved into abstract axiomatics. HM.LMIR.6.10
    11. Solve simple linear congruences of the form ax = b mod m. HM.LMIR.6.11
    12. Use Fermat's Little Theorem and Euler's Theorem to simplify expressions of the form a^k mod m. HM.LMIR.6.12
    13. Use Gauss' Law of Quadratic Reciprocity to determine quadratic residues of two odd primes; i.e., solve quadratic congruences of the form $x^2 = p \bmod q$. HM.LMIR.6.13
    14. Verify that the real primes which can be expressed as the sum of two squares are no longer prime in the field of Gaussian integers. HM.LMIR.6.14
    15. Describe the mathematical contributions of Newton, Euler, and Gauss. HM.LMIR.6.15
    16. Explore the history of African American mathematicians in the 17th, 18th, and 19th centuries and describe their contributions to mathematics. HM.LMIR.6.16
    17. Explore the history of female mathematicians in the 17th, 18th, and 19th centuries and describe their contributions to mathematics. HM.LMIR.6.17

Logical, Mathematical & Investigative Reasoning – 20TH Century Mathematics

7. **Investigate and describe modern mathematicians and their contributions to mathematics.** HM.LMIR.7
    1. Investigate the implications of infinite sets of real numbers. HM.LMIR.7.1
    2. Compare and contrast denumerable and nondenumerable sets. HM.LMIR.7.2
    3. Identify algebraic and transcendental numbers. HM.LMIR.7.3
    4. Describe the mathematical contributions of Cantor. HM.LMIR.7.4
    5. Describe the implications of Klein's Erlangen Programme and Gödel's Incompleteness Theorem on the nature of mathematical discovery and proof. HM.LMIR.7.5
    6. Explore the history of 20th century African American mathematicians and describe their contributions to mathematics. HM.LMIR.7.6
    7. Explore the history of 20th century female mathematicians and describe their contributions to mathematics. HM.LMIR.7.7
    8. Explore the history of 20th century Indian, Asian, Hispanic, Latin American mathematicians and describe their contributions to mathematics. HM.LMIR.7.8